NASA-STD-8739.11 Tutorial
Section C2
Connectors and Contacts

Prepared by Joe Rosol, Code 561/Genesis Engineering

August 11, 2025

Acronyms

AS	Aerospace Standard
AQL	Acceptance Quality Limit
ASQC	American Society for Quality Certification
AWG	American Wire Gauge
°C	Degrees Celsius
CDA	Copper Development Association
COTS	Commercial Off The Shelf
ETW	Electronics Technology Workshop
GSFC	Goddard Space Flight Center
MIL-DTL	Military Detail (Specification)
NASA-STD	National Aeronautics and Space Administration Standard
NEMA	National Electrical Manufacturers Association
PCB	Parts Control Board
RF	Radio Frequency
RMA	Rosin Mildly Activated
ROL0	Rosin-Based Low Activity (Flux Category)
SAE	Society of Automotive Engineers

Connectors & Contacts

- Mechanical devices that terminate the path of electron flow. The electron pathway can continue with the mating of another mechanical device. The choice is heavily influenced by the application.
- Allowing electrical system interconnects facilitate assembly, testing and repairs. The interconnect should have no effect on electrical system performance.
- The guidelines for the selection, test and lot acceptance are based on requirements established for space applications, in accordance with government and industry standards.

Key Considerations

- Mechanical factors required to perform a mate are polarization and locking. Positioning the connector housing is necessary to align the pins to their corresponding sockets. Scoop-proof designs are preferred but not require.
- Typical locking mechanisms are bayonet, ACME thread with ratcheting, breech lock (detent/push-pull), stainless steel latch, and threaded fasteners. Connector housings may be absent of locking mechanisms where the chassis design maintains the seated plug and receptacle.
- Connectors and contacts are selected based on their history of reliability and availability.
- Insulator materials are called out: DAP, PPE, PPS, LCP, PCTFE (Kel-F), PEEK, PTFE, Ultem® (polyetheramide), Vespel® (polyimide)

Key Considerations

- Gender Nomenclature
  - Connector housings exhibit features that may be described as male and female, as do the contacts. However, with many connector designs, the gender affiliations are inconsistent causing conflict. When describing a connector on a parts list, it is recommended to explicitly state whether the connector has pins or socket contacts.
- Stamped Contacts
  - Contacts cut from sheet metal may use the die-cut plane as the asperity surface. A common characteristic is to have a flat burnished surface with shallow parallel ridges and a “break” area with high peaks and valleys. The proportion of what appears between these two surfaces varies and depends on the cutting process. A wear-track analysis will determine which surface feature dominates the asperity points and the extent to which fretting occurs after environmental testing

Key Considerations

- Prohibited Contacts
  - Despite being available within military specifications, the following contact styles are prohibited for Assurance Level 1 and 2 applications and are not recommended for Assurance Level 3. Level 4 applications should understand the risks associated with these contact types. The screening and acceptance lot tables in 8739.11 Section C2 do not apply to connectors listed as prohibited.
    - Flat bifurcated “tuning fork” type female contacts where the asperity area is on the stamped cutting plane
    - Any contact system utilizing only one point of contact.
  - Waivers are required, for example:
    - Single-point interposers
    - Miniature sliding beam contacts (e.g. Samtec SEARAY and Ground Plane connectors)

Key Considerations

- Minimum gold plating thickness of 50 microinches contact gold plating for Assurance Level 1 and 2 applications (recommended for Level 3)
- Prohibited Materials:
  - Cadmium, zinc, chemically coated cadmium or zinc as a connector or contact finish, due to sublimation in vacuum. Cadmium and zinc are also prone to whisker growth which can lead to short circuit conditions.
  - Silver underplate or finish due to corrosion concerns when exposed to atomic oxygen in lower earth orbits
  - Pure tin finish due to the risk of tin whisker growth
  - Nonmetallic materials that exceed 1% TML or 0.10% CVCM when tested in accordance with ASTM-E595. Outgassing occurs in vacuum environments when unreacted additives, contaminants, absorbed gasses or moisture can evaporate from molding materials and ink. These outgassed materials can condense on cold surfaces causing performance degradation. Outgassed materials can also become more rigid or brittle.

Major Changes from EEE-INST-002

- Four assurance levels (Level 4 = COTS use as is)
- Usage requirements: Use As Is, Screening, Lot Acceptance Testing and Destructive Physical Analysis
- Military and industry specifications and test documents were updated
- Contact Screening
  - For bulk or kitted military contacts, follow inspections per SAE-AS39029
  - For bulk or kitted GSFC contacts, follow inspections per the NASA specification
  - For bulk or kitted commercial contacts, electrical and mechanical inspections shall follow ASQC Z1.4, **Level S-1,** AQL 1.0 for major defects
  - For bulk or kitted commercial contacts, contact engagement and separation force inspections shall follow ASQC Z1.4, **Level S-3,** AQL 1.0 for major defects. This reduces the sample size to a reasonable quantity as lots may contain thousands of contacts.
  - For commercial contacts of special designs, including low insertion force styles, the acceptable insertion and extraction force range may be approved by the project.

Major Changes from EEE-INST-002

- Four levels of residual magnetism specified, in Gamma:
  - 20,000, 2,000 (Level A), 200 (Level B), 20 (Level C)
- Hermetic, gas-tight connectors are introduced as a new category. The screening and lot acceptance test align with other rectangular or circular connectors, except there's a high-pressure differential barrier designed in. The screening protocols are appropriate for glass, epoxy and ceramic seals.
- Compliant pin connectors no longer prohibited. Review the NASA contractor's best practices for printed wiring board termination. Their use requires program approval, considering the following:
  - Compliant press-fit connector materials and construction
  - Printed circuit board plated through-hole design and materials
  - Compliant press fit tail insertion, assembly process, and retention forces
  - Screening and qualification testing
  - Rework and repair

Major Changes from EEE-INST-002

- Connector and contact types are listed according to their standard:
  - Circular, Rectangular, Radio Frequency, Hermetic, Filter & Contacts
- Vibration and shock are not listed in LAT tables. The listed acceptable specifications for all connector types include dynamic testing for qualification, or Group B. The setup for this testing is expensive, and it's difficult to predict the input loads to the mated connector. A system level test is an option if deemed necessary based on the dynamic model, or if an interconnect construction technique lacks flight heritage.
- The separate table for GSFC S311P718 and AS81703 push-pull/umbilical connector is deleted, and the screening is included in the circular connector section.
- The coaxial, triaxial & twinaxial connectors are now grouped together under the Radio Frequency connector tables.

Send email to address below for questions

Joseph.L.Rosol@nasa.gov

Backup